Space Weather Technical Forecast

Issued on Saturday, 20 July 2024 at 01:18 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Isolated M-class flares expected. Chance of G1 Minor Storms day 1 (20 Jul)

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Moderate with two M-class flares observed. Peak flare was M3.2 at 19/0823 UTC from AR3753 in the northwest, with an M2.0 also observed at 19/1825 UTC from AR3751. There are fifteen sunspot regions currently on the Earth-facing disc, with the largest and most complex of these AR3751. Some simplification of this region has occurred, consolidating into three main, but still small and rather ragged spots. The interior spot maintains two small delta spots, however, on its northern and southern edge. Rapid growth was also observed in AR3761, a newly numbered and emergent spot to the east of AR3751. While this currently has a relatively simple bipolar structure, any further growth has the potential to destabilise AR3751 further due to its proximity. The other regions on the disc are generally smaller and either stable or decaying. The only exception is AR3759 in the southwest, with some limited growth observed, however this remains a simple bipolar region

A large filament eruption was observed off the south-centre disc just after 19/1930 UTC, with a subsequent filament channel clearly visible on SDO aia-304. A CME likely occurred and despite it having a likely southward bias, an Earth-directed component is possible. However, sufficient coronagraph imagery is currently not available to assess this.

Solar Wind / Geomagnetic Activity: Slow wind conditions largely persisted, however a very small discontinuous increase in the total magnetic field at 19/1610 UTC, was perhaps due a passing transient. It is not impossible that this is related to the anticipated CME, however this is currently considered unlikely, with arrival still expected on 20 Jul. The solar wind speed, as measured by ACE at L1, was at background, 300-350 km/s. Density was average or below. Interplanetary magnetic field (IMF), Bt, was Weak at 2-5nT, before rising but staying Weak at 4-7 nT from 19/1610 UTC. The north-south component, Bz, was variable between +5/-5nT. Phi angle was positive (away from the Sun) until 19/0510 UTC, then rotated to mostly negative (towards the Sun), but with some ongoing variation. Geomagnetic activity was Quiet throughout (Kp 0-1).

Energetic Particles / Solar Radiation: High energy (greater than 10 MeV) proton flux observed by GOES18 remained at Background. High energy electron flux (greater than 2MeV) observed by GOES16 was at Background. The 24-hour fluence was well below Active, with 9.85e5 integrated pfu observed at 19/2100UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Moderate activity is expected with further M-class flares. These most likely from AR3751, however, given the number of sunspots isolated flares are possible from across the disc.

Solar Wind /Geomagnetic Activity: The CMEs from the M1.9 flare at 16/2206 UTC are expected to arrive early day 1 (20 Jul), with any influence easing later that day and into day 2 (21 Jul). Otherwise slow wind conditions are expected to persist. Mainly Quiet geomagnetic

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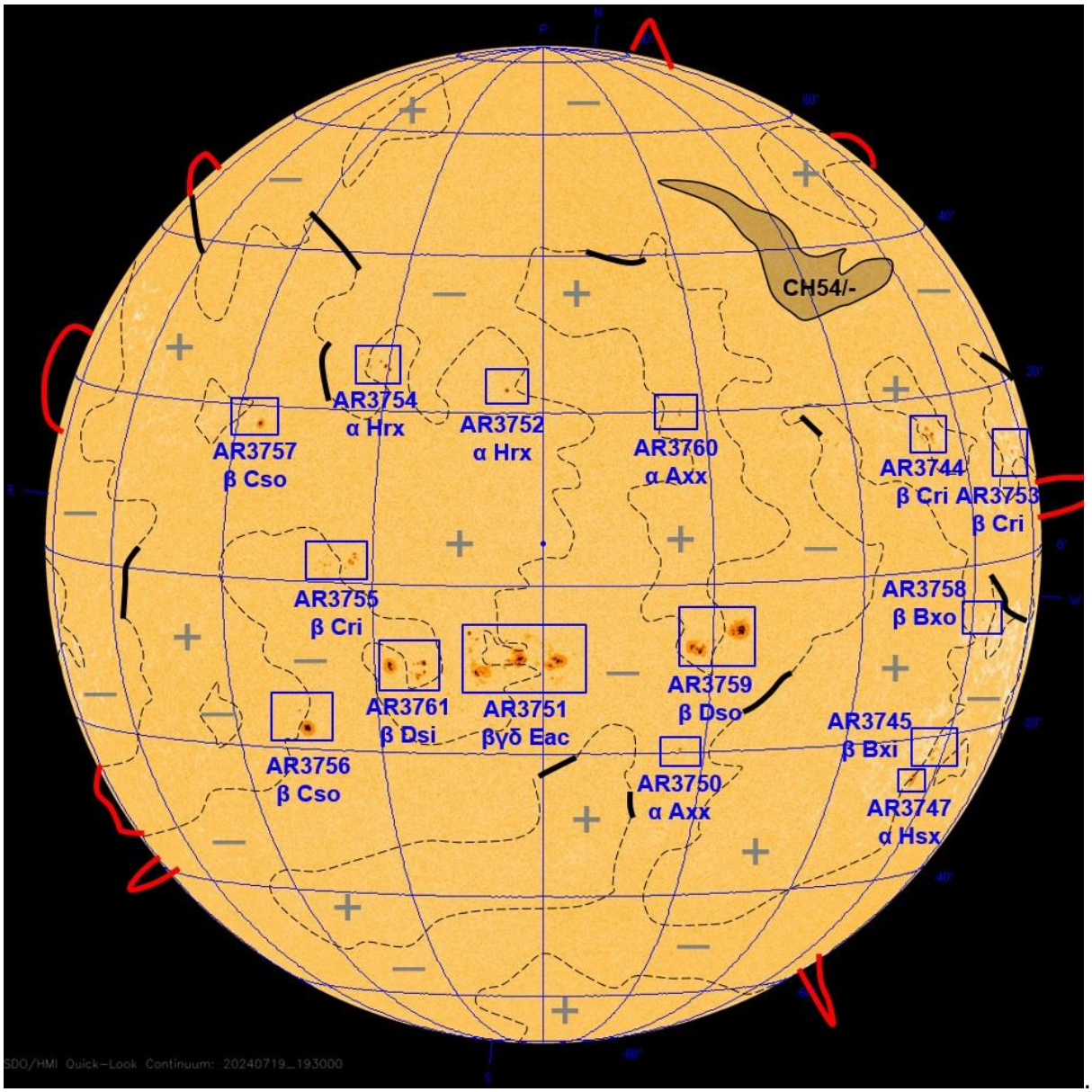
activity is expected overall, but brief Unsettled to Active enhancements are possible day 1-2 (18-19 Jul) from any fast wind interaction, and Active to G1 Minor Storm intervals day 2-3 (19-20 Jul) with any CME arrival.

Energetic Particles / Solar Radiation: High energy proton flux is most likely to remain at background levels, but with chance of rising above the S1/Minor Storm threshold in response to any notable flares, most likely from AR3751 as this moves into and across the western hemisphere. High energy electron flux is expected to remain at background with the associated 24 hr fluence expected to persist below Active.

Figure 1. Solar Analysis Valid 19/2000 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

There are two potential CME arrivals early on day 1 (20 Jul), both associated with the M1.9 flare from AR3744 on 16 Jul. The impact of these are low confidence as they are both relatively slow and weak eruptions, with the second of these perhaps largely shock, with limited material content. It is also possible that the weak transient arrival on 19 Jul was associated with one of the CMEs, however this is currently considered unlikely. A further CME has the potential to arrive later in the period, from the filament eruption off the southeast disc late on 19 July, however this has yet to be analysed.

Otherwise the main feature on the disc is the large coronal hole in the northwest, however any influence from this features fast wind has not been observed at Earth, and is now unlikely to connect. Consequently, aside from the potential CME arrival on day 1 (20 Jul) background slow wind conditions are expected.

Geomagnetic activity is expected to be mostly Quiet to Unsettled, but with a chance of Active to G1 Minor Storm intervals day 1 (20 Jul). Any CME effects gradually waning later day 1 and early day 2 (20-21 Jul), with mainly Quiet conditions returning.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	50	10	1	10
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
17/0334	Nil	M1.9 16/2206 AR3744	N-Centre	691 km/s	19/2200 -6/+12 hrs	Main CME ejecta Limited shock expected
17/0400	Asymmetric Halo	M1.9 16/2206 AR3744	N-Centre	530 km/s	20/1000 +/- 10jrs	Faint halo, probably shock. May not be observable.

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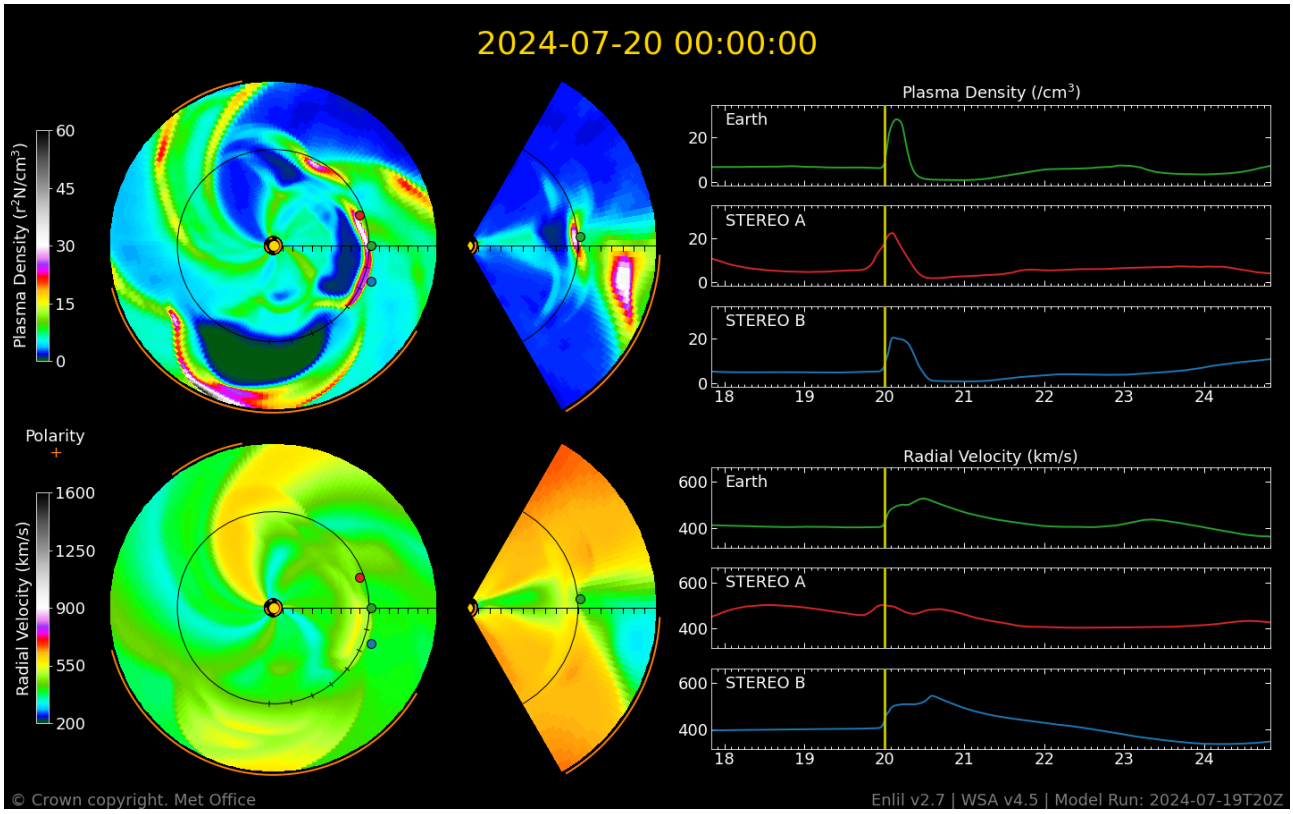
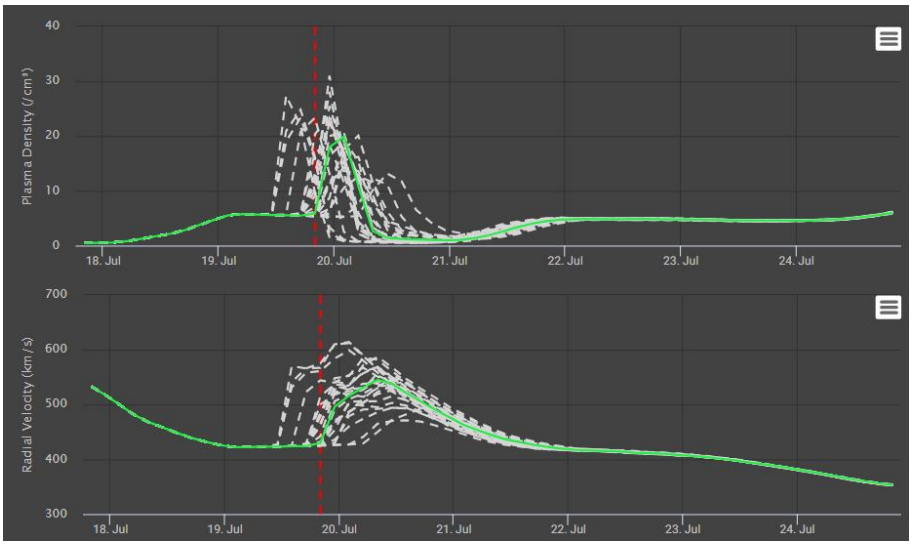
Figure 2: Enlil and Ensemble showing arrival possible early on 20 Jul





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Radio Blackouts - X-Ray Flares:

Moderate activity is expected with further isolated M-flares and a slight chance of X-class flares.

There are fifteen sunspot regions on the disc, with some gradual decay having been observed in a number of the smaller and simpler regions, although for those amongst the extensive plage areas approaching the western limb this may also be an apparent effect due to the increasing viewing angle.

The largest and most complex region on the disc remains AR3751, although this has seen some simplification due to some consolidation of its component spots into three distinct main spots, although the interior one of these maintains a delta configuration on both its northern and southern edge. Also of note is the recent rapid development of a new region to the east of AR3751, and while currently a relatively simple region, this is likely interacting with the magnetic structure of AR3751 and has the potential to bring further complexity and additional instability to the region.

The only other region with notable growth is AR3759 in the southwest, however this has been maturing into a simple bipolar spot. A new region is also rotating onto the southeast limb, however this is currently at too oblique an angle to accurately assess.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	Yes	75	75	70	70
Very Active	R3 to R5 X Class	No	10	10	10	10

Figure 3a: GOES-16/18 X-ray flux

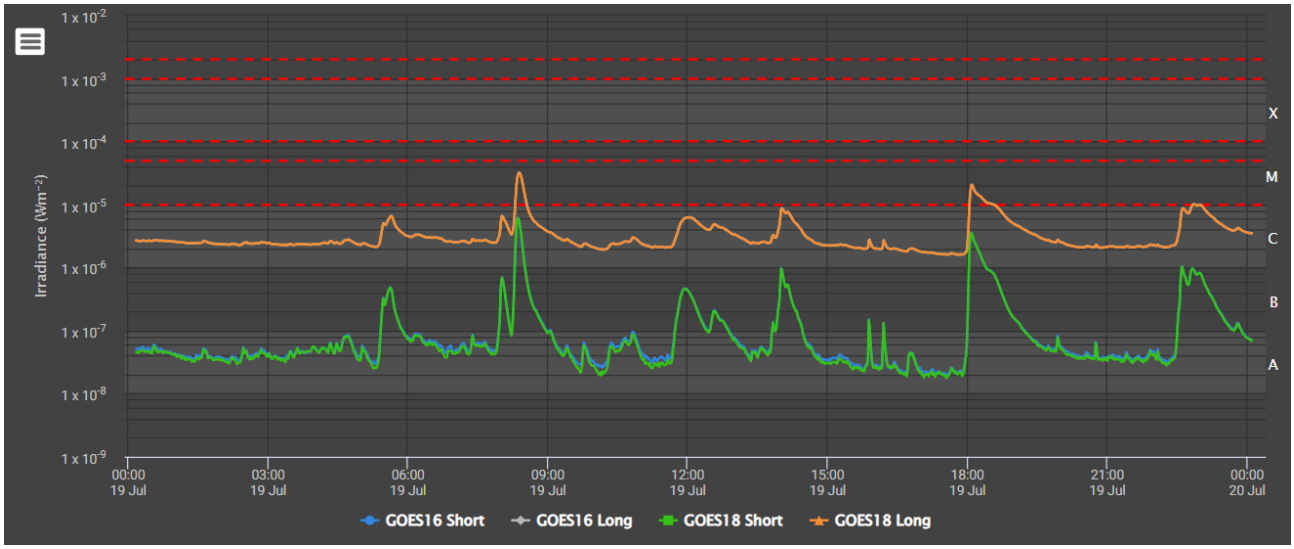

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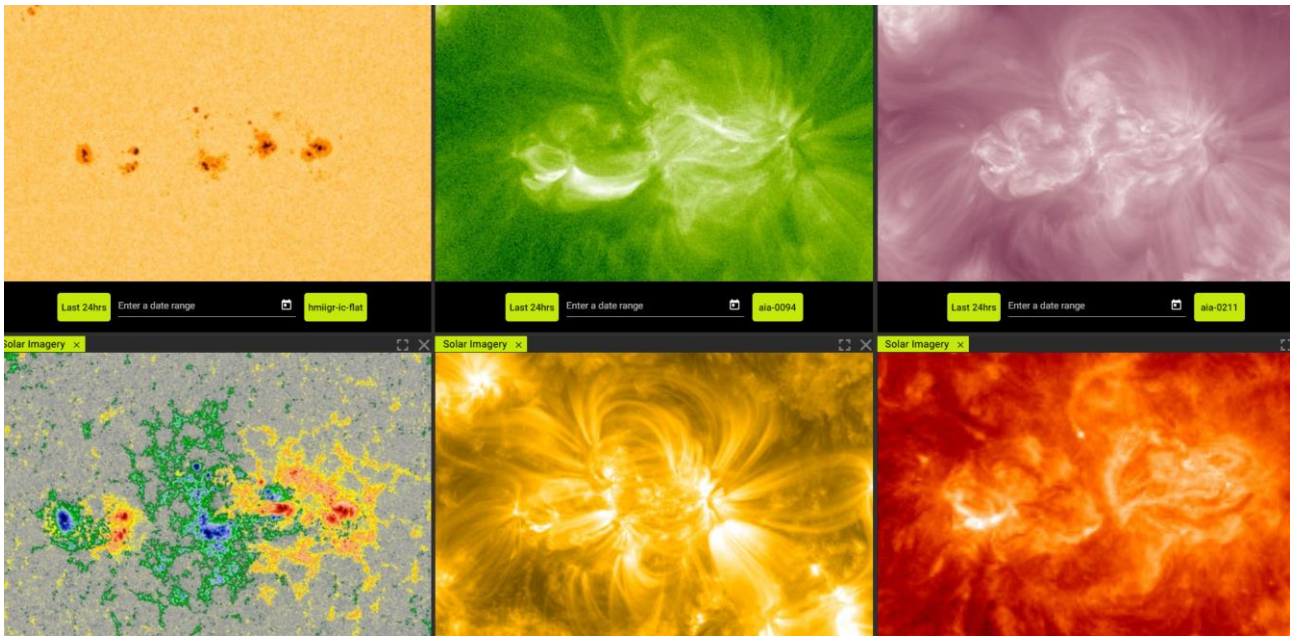
Figure 3b: SDO imagery showing AR3751 (right), and recently emerged AR3761 (left)



Solar Radiation Storms - (High Energy Protons):

High energy proton flux at GOES18 is at background. There is a chance of the observed proton flux rising as a result of any significant flares, currently most likely from AR3751 in the south-centre disc. This potential slightly increases as this regions move into the better connected solar western hemisphere, where high energy protons have a greater likelihood of being towards the Earth due to the Parker Spiral.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	10	10	15	15
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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High Energy Electrons Event (≥ 2MeV):

The high energy electron flux as observed by GOES-16 is currently at background. Given the lack of any notable fast wind enhancement being expected, and any CME influence on day 1 (20 Jul) expected to be relatively limited, background flux is forecast to persist.

The associated electron fluence is expected to persist below the Active level with MOSWOC REFM currently providing good guidance.

GEO Electron Environment	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ $1x10^{8}$	No	1	1	1	1
Very Active	≥ 2 MeV ≥ $1x10^{9}$	No	1	1	1	1

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